

## REMARKS

Claims 1-63 and 88-109 are pending in this application. By this Amendment, (1) the specification is amended to correct typographical errors therein, (2) claims 1-63 and 88-109 are amended to conform the claims to U.S. practice, including correcting grammar and providing proper antecedent basis for terms throughout the claims, (3) claim 110 is canceled, and (4) formal Figures 1 and 2 are submitted and revised formal Figures 3-6 are submitted.

Regarding Figures 3-6, Figure 3 is revised to add the caption "Relevant Art", to remove reference "g" not mentioned in the specification, and to revise "N2" to "N<sub>2</sub>." Figure 4 is revised to add the caption "Relevant Art", to add references A and B mentioned in the specification, and to revise "N2" to "N<sub>2</sub>." Figure 5 is revised to add the caption "Relevant Art", to add references A and B mentioned in the specification, and moves reference "g" to correctly label the collection arm. Figure 6 is revised to add the caption "Relevant Art", to add references A and B mentioned in the specification, to move reference "d" and to add references "e" and "g" mentioned in the specification.

In view of the foregoing amendments and the following remarks, reconsideration of this application is respectfully requested.

### I. Objections to the Drawings

Figure 2, as well as the other drawings, were objected to as allegedly being old. Applicants respectfully disagree that Figures 1 and 2 show only that which is old. As clearly identified on pages 11 and 14 (bottom) of the specification, Figures 1 and 2 illustrate the solid catalyst of the invention. Figures 3-6 illustrate possible devices that may be used in forming the solid catalyst, as explained at various points in the specification. As these devices themselves do not form a part of the present invention, Applicants have appropriately labeled these Figures as "Relevant Art."

The drawings 3-6 were also objected to as not properly including all references in the specification. By this Amendment, the drawings are properly amended as discussed above.

In view of the foregoing, reconsideration and withdrawal of the drawing objection is respectfully requested.

## II. Objections to the Specification

The Abstract was objected to as allegedly containing incomprehensible terms. By this Amendment, the Abstract is revised to address this objection.

The specification was objected to as allegedly being not clear. Applicants disagree. While the specification may not be written with perfect English grammar throughout, it is certainly quite understandable and clear. The specification has been reviewed, and some typographical errors found therein are corrected by this Amendment. As the specification is clear and understandable as presently written, Applicants submit that no further revision thereof should be required. However, if the Examiner has specific additional changes he believes should be made, the Examiner is invited to note such specific changes to the Applicants for review.

In view of the foregoing, reconsideration and withdrawal of the objections are respectfully requested.

## III. Claim Rejection Under 35 U.S.C. §112, Second Paragraph

Claims 1-63 and 88-110 were rejected under 35 U.S.C. §112, second paragraph. Reconsideration and withdrawal of this rejection are respectfully requested.

First, claim 110 has been cancelled by this Amendment.

Second, claims 1-63 and 88-109 have been extensively amended to recite better grammar and to use consistent terminology for antecedent basis. Markush group language has also been revised throughout the claims so as to be proper. These revisions are made in

accordance with the suggestions of the Patent Office in the Office Action, and thus are believed to address several of the issues raised by the Patent Office.

The Patent Office also indicated that it was not clear what was meant by a "quaternary compound." Applicants respectfully submit that such term is well known and understood in the art, and requires no further explanation in the claims to be clear. Specifically, such term refers to any compound having four substituents extending therefrom. Moreover, the types of quaternary compounds intended in the present application by the term are clearly spelled out in the specification. Applicants thus submit that the term is clear in accordance with the requirements of 35 U.S.C. §112, second paragraph.

The Patent Office indicated that the use of "Y<sup>+</sup>" in the definition of the quaternary compounds may be unclear as Y represents yttrium. Applicants disagree. "Y<sup>+</sup>" is clearly defined in the claims with respect to what it represents, and thus clearly no confusion can be alleged to exist.

Finally, the Patent Office indicated that the terms "catalytically active" and "catalytically inactive" (or inert) may be unclear in not defining what these entities are. Applicants respectfully submit that here again, such terms are used and defined consistently throughout the present specification such that these terms are clear and definite to one of ordinary skill in the art as required by 35 U.S.C. §112, second paragraph.

For all the foregoing reasons, reconsideration and withdrawal of the rejection under 35 U.S.C. §112, second paragraph are respectfully requested.

#### IV. Claim Rejections Under 35 U.S.C. §103(a)

Claims 1-63 and 88-110 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 4,248,802 (hereinafter Kuntz) in view of U.S. Patent No. 4,994,427 (hereinafter Davis). This rejection is respectfully traversed.

In the Office Action, it was alleged that Kuntz describes the invention as claimed except for the compound being supported on a solid support, and that Davis suggests supporting the compound of Kuntz on a solid support. Applicants submit that the combined teachings of Kuntz and Davis would not have led one of ordinary skill in the art to the claimed invention.

Kuntz discloses a process in which olefins are hydroformylated to aldehydes in the presence of a catalytic system comprising a rhodium containing, aqueous solution of certain sulfonated aryl phosphine compounds. As properly recognized by the Patent Office, Kuntz fails to teach or suggest a catalyst including a solid support.

As was discussed in the present specification, among the established practices known in the art, catalytically active transition metal complexes have principally been applied in homogeneous form, as a solution in a reactant phase, as in Kuntz. Kuntz describes, in the case of hydroformylation of olefins using a rhodium and phosphine ligand complex catalyst wherein the phosphine ligand is free of ionic charge (such as tributyl phosphine, triphenyl phosphine, etc.) and soluble in the reaction medium. Although such catalysts may be highly effective in terms of productivity and selectivity, its applicability on practical grounds is often limited to volatile products. In case of reactions catalyzed by homogeneous catalysts involving high molecular weight, and especially nonvolatile products, catalyst separation is a critical problem. The high cost of catalysts, the susceptibility to high temperatures, and stringent product specifications demand quantitative catalyst separation. Organometallic complexes are delicate in nature and cannot withstand separation stresses such as thermal stresses encountered in distillation. Other separation techniques are inefficient in separating such a small quantity of catalyst and thus cannot be used in an effective manner. Moreover, high purity of the product is of importance in products such as pharmaceuticals, demanding

rigorous separation of catalyst from product stream. Thus, use of homogeneous catalysts has suffered from inherent difficulties.

Further, aqueous solutions of sulfonated aryl phosphines and many other water-soluble compounds and transition metal complex catalysts derived from it are used to effect reactions. The reactions described in Kuntz are operated in biphasic conditions, wherein the catalyst phase is aqueous and products and reactants are dissolved in an organic phase. A judicious choice is necessary while utilizing biphasic catalytic systems depending upon solubility of reactants and products. In either case, at the end of reaction, catalyst and product phases are separated, and the catalyst phase is recycled while the product phase is directed for further downstream processing. It is however recognized that catalytic activity is low in biphasic mediums due to the limited solubility of organic reactants in the catalyst phase. Moreover, such biphasic reactions require high reactor pressure in case of gas-liquid reactions. To achieve practical rates of reactions, catalyst loading has to be increased or, alternatively, larger process equipment must be used (which is usually cost prohibitive). Further, these reactions require numerous additional pieces of equipment to separate liquid-liquid reactions under reaction conditions.

From the foregoing, it is evident that the known catalyst system of Kuntz is quite limited and very different from the catalyst composition recited in present claims 1-52. Davis does not remedy the deficiencies of Kuntz.

Davis describes a catalyst comprising a solid surface having immobilized thereon an aqueous solution of one or more organic complexes of rhodium. The catalyst is useful for promoting hydroformylation, hydrogenation and other chemical reactions in essentially water-immiscible organic liquid reactant phases. See the Abstract.

Supported liquid phase catalysts such as those described in Davis are critically sensitive to the character of the reaction medium and are often leached in to reaction medium,

depending upon the nature of the solvent. The applicability of such catalyst is thus known to be limited to only vapor phase reactions. Davis describes a solution of a water-soluble catalyst that is distributed on a high surface area solid. The aqueous film of catalyst containing solution remains insoluble in a non-polar organic phase. Thus, after reaction, solid catalyst can be recovered by simple filtration. Applicability of such a catalyst is limited to reactions involving water insoluble reaction media. Moreover, such catalysts are sensitive to the content of water. In addition, the catalyst is dissolved in a liquid, which is immobilized on a solid support.

In the present invention, the catalytic entity is a solid, which is present on a solid support. The present invention pertains to a catalytic entity which itself is a solid that is, e.g., precipitated on a solid support. The catalytic entity mentioned in Davis, to the contrary, is soluble in a liquid supported on a solid support, which is a completely different concept from the present invention.

Davis thus describes an aqueous catalyst immobilized upon a solid surface. The aqueous catalyst system of Davis is not the catalyst system of Kuntz, contrary to the assertion of the Patent Office. One of ordinary skill in the art would not have been led to have included the catalyst of Kuntz, having a different nature and use in practice, upon a solid surface based upon the teachings of Davis.

Kuntz and Davis are not related to the presently claimed invention of claims 1-52, and the citations cannot be relied upon to reach the claimed catalyst. The catalyst of the invention is a solid catalyst that is able to be used with polar as well as non-polar reaction media, unlike either of the catalysts described in Kuntz and Davis. Kuntz and Davis cannot be combined by anyone skilled in the art to develop a catalyst system as claimed in the invention. Kuntz has demonstrated the synthesis and use of water soluble catalysts for catalytic reactions. Davis employs dissolution of a water soluble catalyst in a thin film of water supported on a surface

like silica. Nowhere it is mentioned that the catalyst is directly bound to the support or is in a solid state. Davis requires a liquid medium in which the catalyst is dissolved, which is only then dispersed upon a solid surface.

In the present invention, a solid catalyst is precipitated onto a solid support, and is not dissolved in a liquid phase supported on a solid. It is thus not possible to extend the art of making a water soluble catalyst and that of supporting a liquid phase to a truly solid phase heterogeneous catalyst as in the present invention. The precipitation of a catalyst onto the support and its application in the absence of any solvent for the catalyst dissolution is a unique feature of the present invention which is not an obvious extension from Kuntz and Davis. The present invention reports synthesis of inherently solid phase catalysts insoluble in both aqueous and organic media, while showing catalytic activity and selectivity.

Finally, Applicants note that neither Kuntz nor Davis, alone or in combination, teach or suggest any of the preparation methods recited in claims 53-63 or 88-109 of the present application.

For the foregoing reasons, reconsideration and withdrawal of this rejection are respectfully requested.

V. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1-63 and 88-109 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



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JAO:JSA:CWB/cwb

Attachment:  
Appendix

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